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Agricultural nature conservation in the Netherlands: Three lenses on transition pathways

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ABSTRACT

In this paper three approaches on transitions pathways are combined to study the role of agricultural nature conservation in the Dutch land use domain for achieving internationally agreed climate and biodiversity targets. The three perspectives used are the Multilevel Perspective (MLP), Initiative Based Learning (IBL) and Integrated Assessment Modelling (IAM). The analysis provides insights in how the combination of different research approaches can lead to more comprehensive policy advice on how agricultural nature conservation could help to achieve internationally agreed sustainability goals related to climate change and biodiversity. IAM shows under which conditions agricultural nature conservation could be consistent with European and global long-term goals regarding food security, biodiversity and climate. MLP provides insight into the extent in which agricultural nature conservation has affected or changed the existing nature and agricultural regimes. IBL, finally, reveals the challenges of encouraging agricultural nature conservation with policy measures. Our analysis shows that a combined perspective provides a deeper understanding of the underlying processes, reasons and motives of agricultural nature conservation, leading to more comprehensive policy recommendations.

1. Introduction

In order to achieve internationally agreed sustainability goals related to biodiversity and climate change, tremendous changes away from business as usual are required. Land use plays an important role in such a transition pathway, as many environmental, social, and economic sustainability goals relate to land use and the affiliated externalities (Fischer-Kowalski and Rotmans, 2009). More concretely, habitat loss due to land use change is often considered to be a primary driver for biodiversity decline (Pereira et al., 2012). Furthermore, land use is responsible for a large share of greenhouse gas emissions, with carbon dioxide (CO_2) emissions from forestry and other land use contributing about 10% to global emissions (IPCC, 2014). Changes in land use are therefore crucial for achieving biodiversity and climate targets, such as agreed under the Convention on Biological Diversity (CBD) and the Paris Agreement (UNFCCC, 2015), while at the same time the important role of land for food production has to be acknowledged.

A vast number of actors and institutions on very different levels are involved in the way society uses land, from individuals and farmers to companies or social groups to national or supranational systems. Hence, transition pathways in the land use domain are complex processes in many ways (Berg, 2013; Manson, 2001; Mittleton-Kelly, 2003). As an important share of land is used for production of food and feed (in Europe 43.8% in 2014; World Bank, 2017), attention for combining agricultural production with for example nature conservation to improve the ecological resilience of land use is increasing. Improved knowledge is needed for the design of new agricultural systems that combine ecological resilience with efficient technologies. Research can contribute to this by providing insight into transition pathways and deriving implications on how these can be governed (cf. Gibbons, 2000; Schneidewind and Singer-Brodowski, 2014).

Given the complexity of the task, it is more than unlikely that one scientific school, method or discipline can capture and understand the whole antecedents, prerequisites, processes and outcomes that relate to transition pathways (Foran et al., 2014; Geels et al., 2016; Turnheim et al., 2015). Methods and procedures to interpret transition pathways from different scientific angles need to be applied, the findings of which should be combined or compared in what could be understood as an effort of inter- and transdisciplinary triangulation (Campbell, 1975). Combining the findings made by different approaches may lead to a more encompassing and robust understanding of the processes, outcomes, and impacts of transition pathways. They may thus also produce

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more appropriate and legitimate implications for practice and policy (Dewulf et al., 2005).

In this context, Geels et al. (2016) argue that low-carbon transitions are best analysed through a combination of the following analytical approaches: i) rational goal-oriented analysis with Integrated Assessment Modelling (IAMs), culminating in a vision or general plan, ii) identification of feasible and legitimate pathways with socio-technical analysis using a multi-level perspective (MLP), and iii) assessments of real-world initiatives and projects to explore transition pathways and emerging options using initiative-based learning (IBL). Each of these approaches has its own view on transition pathways and there are several reasons why these approaches complement each other. IAMs usually take a goal-oriented approach by starting from a specified long-term target (such as the 2 °C climate target) to analyse transitions, using backcasting to determine which kind of changes are needed to achieve such a target. Due to their comprehensive representation of global systems, IAMs allow to evaluate the implications of different policy decisions on both the human and natural system, taking into consideration interactions between these systems. However, due to their focus on aggregated universal processes, various institutional, political, social, entrepreneurial and cultural factors are usually underrepresented. Therefore, the scenario outcomes could be considered as offering rather narrow technology-oriented perspectives on governance aspects (Anderson and Peters, 2016; Peters, 2016; Stern, 2016; Victor, 2015). MLP analysis can fill this gap, as such analysis explicitly studies the role of governance and actors in transitions. In MLP, transitions are defined as "alterations in the overall configuration of transport, energy and agri-food systems, which entail technology, policy, markets, consumer practices, infrastructure, cultural meaning and scientific knowledge" (Geels, 2011 p. 24). MLP analyses, however, have a limited goal-oriented and forward-looking view as they usually focus on identifying changes of systems and on what has happened in the past. However, especially for analysing transitions related to achieving sustainability goals, goal-oriented analysis is important (Geels, 2011; Smith et al., 2005). Here, IAMs complement MLP by their strong forward-looking and goal-oriented focus. Both IAM and MLP analyses disregard the local level where transitions often begin: i.e. real-life development and the direct processes related to transitions, which is the focus of IBL. IBL is the foremost action oriented approach. Contrary to most IAM and MLP research, IBL strongly adopts participatory approaches aiming to instilling change in the course of its research undertakings (as in Berg et al., 2015).

Given the above differences in views of transition pathways and approaches to analyse them, we follow Turnheim et al. (2015) in our definition of transition pathways: *patterns of changes in socio-technical systems unfolding over time that lead to new ways of achieving specific societal functions*. This captures both the MLP and IAM perspective on transition pathways: the MLP perspective focuses especially on the changes in socio-technical systems, while the orientation of achieving sustainability goals is captured by the new ways of achieving specific societal functions. Transition pathways here thus take an active connotation, concerning themselves in what way(s) change may be effected rather than what changes may occur or may be observed.

In this paper we apply this set of approaches to study developments in agricultural nature conservation in the Netherlands as a practice in land use, with the aim to gain insights on whether and how it could help to achieve internationally agreed sustainability goals related to climate change and biodiversity. Here, agricultural nature conservation is understood as a transition in agricultural land use from intensive crop production towards a multifunctional land use in which food and feed production is combined with other functions of the landscape, such as water storage and providing a diversity of plant and animal species. In the broadest sense, agricultural nature conservation refers to the measures farmers are taking on and surrounding their farms that help to protect the landscape (managed and natural), with agricultural production remaining the most important function. Different forms of agricultural nature conservation measures can be distinguished, including species, border, and parcel management (Agriholland, 2015). The Netherlands was chosen for our study as it is a small country with high population density, so that every place has one or more particular functions.

Although the three approaches are developing and responding to criticisms (see e.g. Geels, 2011), every approach has its own characteristics, methodologies and focus. Therefore it is helpful to keep them distinct, in order to develop a richer picture (Geels et al., 2016). This paper provides a first, exploratory attempt to combine the insights from three different research approaches on transition pathways by comparing, contrasting, and combining results derived from these approaches, based on the framework developed by Turnheim et al. (2015) and Geels et al. (2016).

The paper proceeds as follows. Section 2 characterises the three approaches and lays out the procedures for the joint approach taken here. It points out what the approaches can contribute and what their specific advantages and limitations are in understanding a transition in agricultural land use. Section 3 outlines the present transition process in the Dutch agricultural land use domain and offers relevant insights gained from applying the three approaches individually. In Section 4 the findings are combined to point out how a combined analysis leads to more comprehensive policy advice than single-approach undertakings. Section 5 provides a discussion.

2. Theory

2.1. Integrated Assessment Modelling

Integrated Assessment Models (IAMs) have been developed to describe key processes in the interaction between human development and the natural environment on a global scale. They provide a dynamic and long-term perspective of global environmental change by developing scenarios. These scenarios are based on socio-economic and policy storylines and some of them capture both direct and indirect land-use change.

IAM methods and tools draw on functional relationships between activities, such as provision of food, water and energy, and the associated impact (Stehfest et al., 2014). These impacts include climate change, air pollution, water quality, water scarcity, depletion of non-renewable resources (e.g. fossil fuels, phosphorus), overexploitation of renewable resources (e.g. fish stocks, forests), and effects on biodiversity (for IAMs which include models to assess this). IAMs can be a useful starting point for more detailed regional assessment, but they do not capture all impacts – changes in certain habitats, for instance, may be better identified by empirical studies (Meller et al., 2015).

IAMs are particularly useful to:

- Assess the relative importance of different linkages within the society-biosphere-climate system;
- Analyse the strength of different interactions and feedbacks;
- Estimate the consequences of various policy measures.

As an example, Fig. 1 shows the interactions in the IMAGE integrated assessment model framework (Stehfest et al., 2014). IMAGE consists of a set of interlinked models, including an energy, climate, agriculture and land use, and biodiversity model. In the IMAGE model framework, global changes in agriculture and land use are affected by drivers such as population and economic growth, policies, technologic change, lifestyle change, and change in resources. Agriculture and land use interact with energy supply and demand, for instance via bio-energy. Changes in land use affect the Earth system, such as vegetation, nutrient cycles, the water cycle, and the climate via changes in land use emissions.

An important limitation of IAMs is oversimplification of the transition process, due to only a limited attention to actors and their

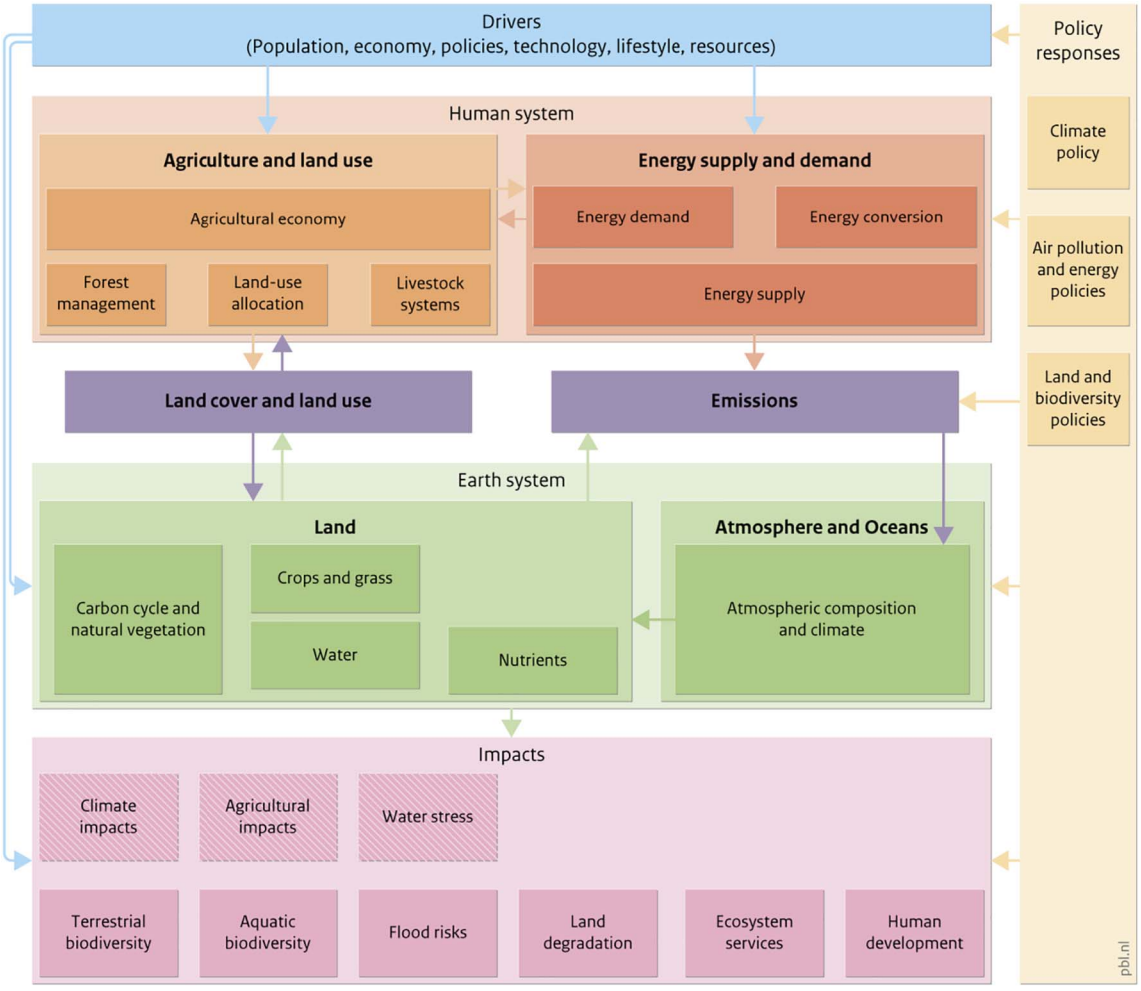

Fig. 1. IMAGE framework (Stehfest et al., 2014).

behaviour in these models. Furthermore, the scale of the model is important. A global model is not suited for regional or local analysis. However, global scenarios can quantify the impact on land use changes at a regional level, inform the debate on how actions affect opportunities and needs, and can help identifying potential conflicts between different goals (Meller et al., 2015). The focus of IAMs is on economic mechanisms, often ignoring societal considerations. Furthermore, there is only limited attention to policy implementation. On the other hand, quite a number of explicit and implicit assumptions on factors like learning and investments are applied. The research and data behind these assumptions guide the interaction of cause and effect in the models. The realism of these assumptions is hence crucial to the validity of the models.

2.2. Socio-technical analysis in a multi-level perspective

"*Socio-technical analysis*, […] investigates interactions between technical and social dimensions (including economic, cultural and political dimensions). It is sociological in the sense of focusing on the various groups of social actors that interact in the reproduction and change of socio-technical systems" (Geels et al., 2015, p. 4). The approach relies on the Multilevel Perspective (MLP) in which the interdependent relations, dynamics and impact of three distinct levels are analysed: niche innovations, socio-technical regimes, and socio-technical landscape (Geels, 2002; Geels and Schot, 2007). Niches are conceptualized as the micro-level in which radical innovation originates; they are formed by local projects that eventually join to constitute niches as higher order analytical entities. Regimes influence all related processes in their area of dominance, stabilizing a system's trajectory through mechanisms such as sunk investments, dominant customs, networks etc. The socio-technical landscape resembles the exogenous environment of a regime and is not susceptible to the influence of niche and regime actors (for a more distinct conceptualization of all three levels, see Geels and Schot, 2007). From a socio-technical transition perspective transitions can be pictured as in Fig. 2. In the context of agricultural land use, agricultural nature conservation can be called a niche: it is a development that differs from mainstream agricultural production (agricultural regime) and nature conservation (nature regime) and demands different approaches to land use. So, this niche is influencing both the agricultural and nature regimes. Both regimes have their own institutions and actors involved that influence the development of a niche.

According to Geels and Schot (2007) a transition pathway can be characterised based on timing and the nature of the interaction between niches, regimes and the landscape. The timing is about the state of the niche developments at the moment landscape pressure is increasing. The nature of interaction is about the relationship between niche innovations and the landscape developments: is there a reinforcing or disruptive (pressure and competition) relationship with the regime? Based on this categorisation they came up with four transition pathways: transformation, de-alignment and re-alignment, technological substitution and reconfiguration pathways.

An important strength of this approach lies in its deep attention to the specific contexts and nuances of (historic) real-world processes and

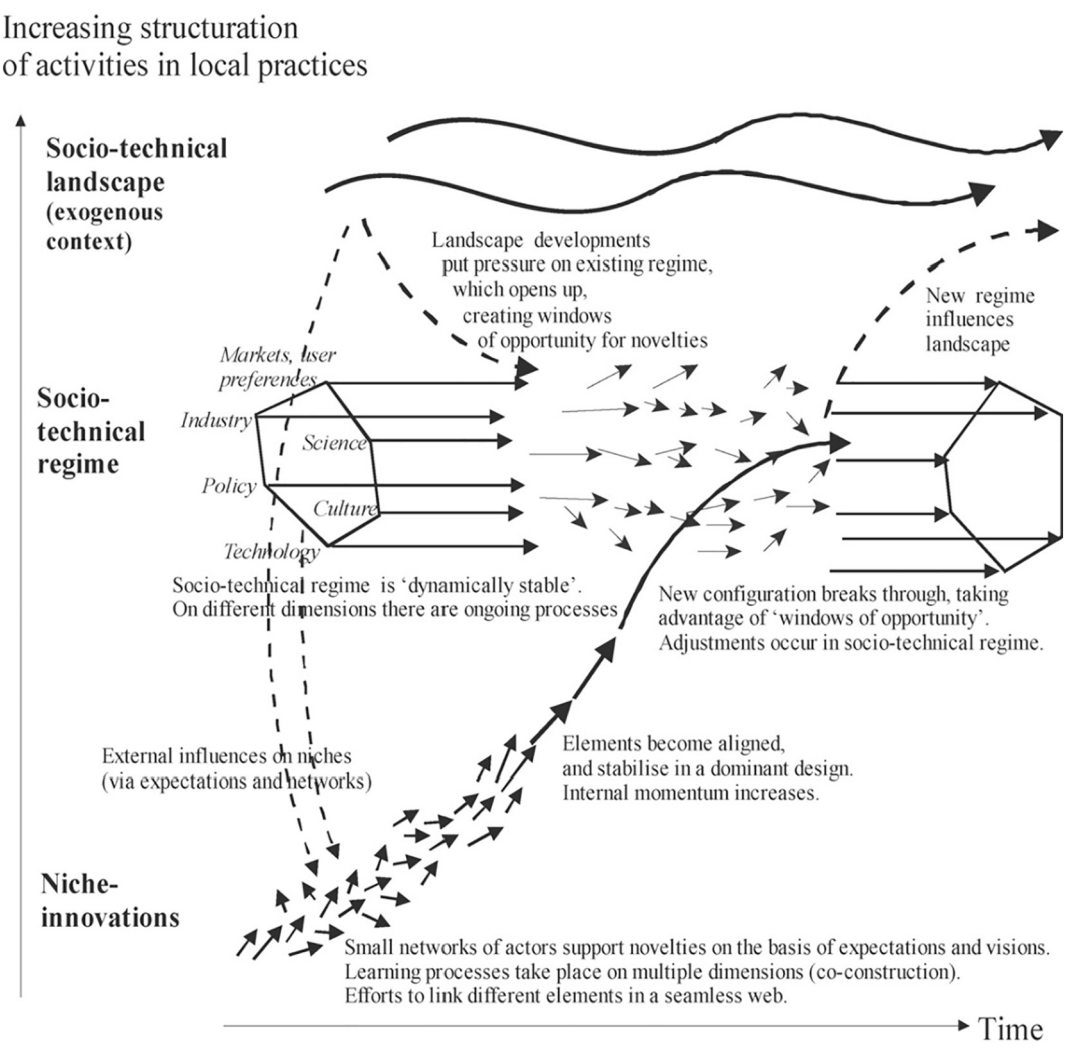

Fig. 2. Multi-level perspective on transitions (Geels and Schot, 2007 p. 401).

in the consideration of a broad range of interdependent influences such as agency, institutional constellations and development, as well as mechanisms such as path dependency and causation (Turnheim et al., 2015). As most evolutionary oriented research approaches, this approach is limited with regard to its predictive capabilities and is more stylized and less tangible than e.g. initiative-based learning. Due to a mainly descriptive and qualitative character, generalisation is limited. Recently, there has been an increasing attention for agency and actors in MLP literature (see e.g. Farla et al., 2012). However, for IBL these themes are the main focus.

2.3. Initiative-based learning

IBL deals with the emergence, development and impact of real world activities that seek to instigate, replicate or cope with efforts that lead to regime transitions or emerge from them. It "focuses on real-life projects driven by a diverse set of actors that work as catalysts and nuclei for innovation towards transitions" (Berg et al., 2015, p. 5, Turnheim et al., 2015). As such, IBL concentrates on which lessons can be learned from 'transitions in the making'.

IBL can be related to local projects, using a diverse set of research methods to observe, explain or even support initiatives. For example, these activities can be analysed in traditional case studies with the researcher as an observer, acting according to classic case study aims and methodology (as laid out by e.g. Eisenhardt (1989) or Yin (2014)). More pro-active approaches, in the sense of actively intervening into a regime or instigating a transition, seek to actively affect and promote a transition (WBGU, 2011). Such approaches may include experimental settings like participatory action research (Ozanne and Saatcioglu, 2008), LivingLabs (Liedtke et al., 2013) or real-world laboratories (Wagner and Grunwald, 2015). IBL also has a distinct aptness of producing concrete actionable knowledge for this level of analysis (Argyris, 1996; Castree et al., 2014). IBL thus provides insights into the processes within innovative projects. It is set where transitions begin, take-off or fail. These processes are generally not very transparent, as they are actor driven and affected by phenomena like ambitions, in-group interaction, network effects, needs for resource acquisition etc. (Berg et al., 2015) They are hence of a less ordered or even messy character (Kirchhoff et al., 2013).

Strengths of this approach relate to its concreteness and orientation on problem solving or uptake. Of the three approaches included in this study, it is closest in respect to real life development and the direct processes involved in transitions. In return, it is less capable of deriving lessons regarding the "bigger picture" and its findings may be difficult to generalise, as they can be context-dependent (Turnheim et al., 2015). Especially in the case of land use it is hard to foresee what will happen in the future, as developments in land use take some time before effects on, for example, biodiversity are visible.

2.4. Combining the approaches

Table 1 summarizes the characteristics, strengths and weaknesses of

Table 1
Comparison of MLP, IAM and IBL foci, characteristics, strengths and weaknesses. Adapted and expanded from Geels et al. (2016) and Turnheim et al. (2015).

	IAM	MLP	IBL
Main focus	Technological potential to achieve goals Benefits and costs Support formulation of (international) strategy documents	Provides insight into the factors that determine (the success of) a transition	Behaviour and motivation of actors as starting point Enabling conditions Adoption of new technologies
Dynamics	Long term dynamics (30 + years) Future oriented	Long term dynamics (30–90 years) Historically oriented	Present and recent history (5–15 years) Orientation on current situation
Methodology	Quantitative modelling approach linking policy goals to required physical changes	Review of literature incl. policy documents Interviews	Qualitative approaches Real-world experiments
Strengths	Robust and highly formalized research methods Consistent analysis of complex systems Attention to system and problem interactions Simple and coherent policy advice	Attention to multiple actors and behaviour types Analysis of institutions and changing 'rules of the game' Attention to inertia of existing systems. Policy advice sheds light on uncertainties	Closeness to real-world complexity Engages in real-world initiatives as experimenters Relevance to stakeholders Attention to concrete implementation Policy advice is rooted in practice
Weaknesses	Oversimplification Little attention to actors and behaviour Over-reliance on economic mechanisms Limited attention to policy implementation	Mainly descriptive: limitation in generalisation Limited forward orientation to targets Policy advice often on general strategies rather than instrumentality	Limited methodological standardization Often context-specific and short-term orientated Limited attention to wider context Difficult to generalise
Inputs	Socio-economic data on population, GDP, policies, lifestyles Technology assumptions on costs and potentials Resource availability	Meta-studies, literature, expert opinions	Interaction with local initiatives e.g. through participative action research, LivingLabs, ethnography, etc.
Outputs	Information on various pathways to achieve long-term goals	Information on barriers and opportunities in the past	Information on perspectives of individual actors and enabling conditions
Mutual enrichment	IAM → MLP: provides sectoral targets and context IAM → IBL: provides context for case studies	MLP → IAM: information on impact of actors/feasible actions MLP → IBL: context for case studies	IBL → MLP: provides detailed information on implementation IBL → IAM: provides detailed information on implementation and innovation processes in reality

the three approaches. Although they are all interested in change, the table shows how distinct the approaches are from each other in terms of focus, perspective on time, and methodology. This underlines the argument that in combination with the other two, the findings created by a single approach can be utilized to strengthen the understanding of and action for more sustainable land use as a whole.

Fig. 3 describes the information flow between the three approaches. IAM provides the context for both socio-technical analysis and initiative-based learning. With their different foci MLP is then employed to understand the qualitative assessment as to which barriers uphold the current regime, and which cracks exist therein to create a foothold for change. IBL, on the other hand, is used to identify the struggles and opportunities real world action is faced with. It thereby generates insights in implementation issues regarding agricultural nature conservation as a practice for improved land use. The combination of all three approaches is then employed to derive implications for policy that can foster more sustainable land use through agricultural nature conservation.

3. Findings from the research approaches

3.1. Findings from the IAM perspective

One of the major questions related to agricultural nature conservation addressed by IAMs is whether and how multifunctional land use, and especially agricultural nature conservation, could fit in a pathway that achieves biodiversity and other sustainability targets simultaneously. In an IAM approach Van Vuuren and Kok (2012) and Van Vuuren et al. (2015) have analysed alternative global pathways to achieve multiple sustainability goals by 2050. Long-term relationships between two clusters of sustainable development issues were analysed: food, land, and biodiversity on the one hand, and energy, air pollution, and climate change on the other hand. In one of these pathways (coined *Global Technology*), there was a strong technology-focus with intensive agriculture, potentially leading to land sparing (Phalan et al., 2011; Tilman et al., 2011). In another pathway (*Decentralised Solutions*), agriculture was assumed to be interwoven with natural corridors and national policies that regulate equitable access to food potentially leading to land sharing (Tittonell, 2014; van Noordwijk and Brussaard, 2014). The *Decentralised Solutions* pathway has strong similarities with our case study in which agricultural production and nature conservation are combined. In a separate study, Kok and Alkemade (2014) specifically addressed the contribution of the agricultural sector to the realization of biodiversity targets for the same pathways. Contrasting these two pathways provides insight in the conditions under which a scenario in which agricultural nature conservation is targeted can achieve multiple long-term sustainability targets compared to a scenario in which it is not.

The *Global Technology* pathway reflects dynamics that lead to separation of agriculture and nature and can result in land sparing, reducing pressures on existing nature, and making space for rewilding. The *Decentralised Solutions* pathway reflects land-sharing dynamics leading to better use of ecosystem services and more natural agriculture, but also a larger land requirement. Such landscapes can improve local ecosystems and connectivity between natural areas, but production improvements are easier to achieve in mono-functional agriculture by using cutting edge technological refinements, agronomic optimisation of the farm environment, and new animal breeds and crop varieties that perform best under these optimised conditions. However, this may lead to more local biodiversity loss compared to multifunctional land use. In multifunctional landscapes, higher yields may be achieved by combining the services provided by natural processes with technological advanced measures.

The IAM analysis shows not only the impact of multifunctional land use on greenhouse gas emissions and biodiversity loss, but can also help to show which type of practices are in line with long-term climate and biodiversity targets and food security – and on the regional potentials of the scenarios. IAM shows that agricultural nature conservation can fit into different scenarios in which both biodiversity and climate targets are achieved, without endangering food security. However, as multifunctional land use is likely to lead to lower productivity improvements, additional measures are needed to both maintain farmer's

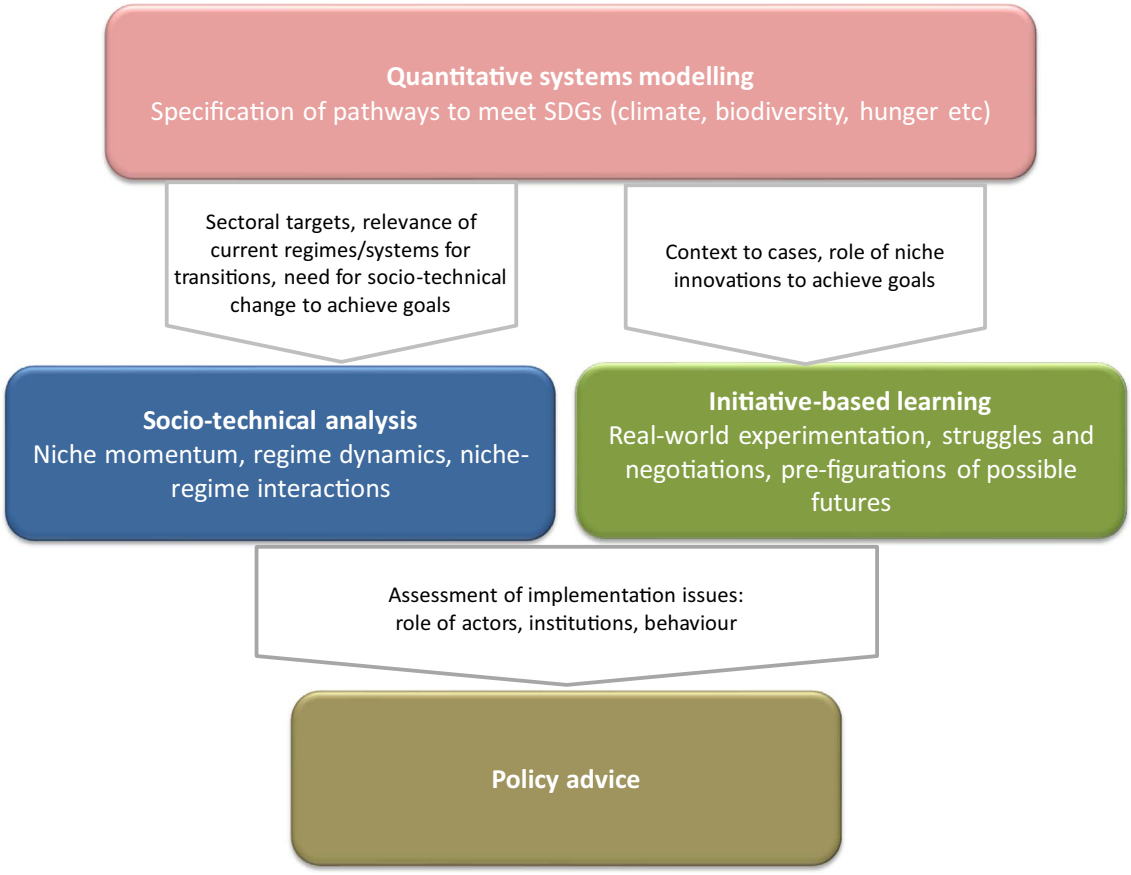
Quantitative systems modelling
Specification of pathways to meet SDGs (climate, biodiversity, hunger etc)
Sectoral targets, relevance of current regimes/systems for transitions, need for socio-technical change to achieve goals
Context to cases, role of niche innovations to achieve goals
Socio-technical analysis
Niche momentum, regime dynamics, niche-regime interactions
Initiative-based learning
Real-world experimentation, struggles and negotiations, pre-figurations of possible futures
Assessment of implementation issues: role of actors, institutions, behaviour
Policy advice

Fig. 3. Schematic representation of steps in a combined analysis of future-oriented transition pathways. (Adapted from Turnheim et al., 2015.)

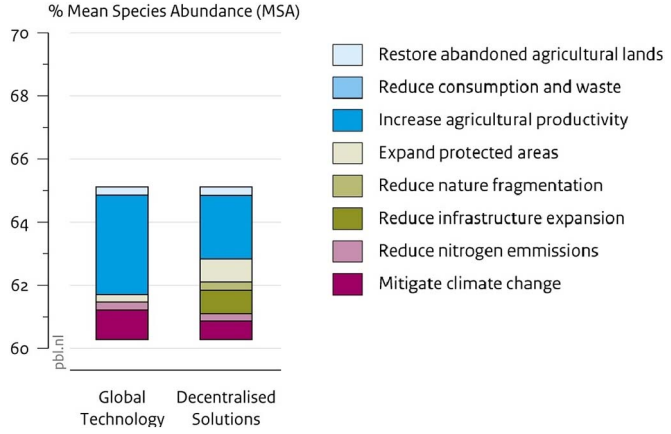

Fig. 4. Options for reducing biodiversity loss in alternative scenario's (Van Vuuren and Kok, 2012). The indicator used for biodiversity in this figure is mean species abundance (MSA), which uses the species composition and abundance of the original ecosystem as a reference situation. If the indicator is 100%, biodiversity is assumed to be similar to the undisturbed state, implying that the abundance of all species equals the natural state. If the indicator is 50%, the average abundance of the original species deviates by 50% from the undisturbed state.

income and to achieve biodiversity targets (Fig. 4). In uncultivated areas, these additional measures could consist of limiting infrastructural expansion and expanding protected areas. The study also shows that mono-functional and multi-functional agriculture land use both have significant scope for increased and more sustainable production, but both require improved land-use planning and will result in different types of biodiversity.

The analyses by Kok and Alkemade (2014) showed that substantial efforts will be needed to fulfil the conditions on which these pathways are based. For the *Global Technology* pathway, one of these conditions is that in the developed regions of the world, the annual yield increase needs to be the same as the average over the past 20 years (1.3%). It will be challenging to achieve this, as agricultural productivity is already high in developed regions. This challenge can be illustrated by comparing the required yield increase in developed countries to the FAO projection of an annual 0.7% increase for the 2006–2050 period for the world as a whole (Alexandratos and Bruinsma, 2012). In the *Decentralised Solutions* pathway, productivity increase will come from ecological solutions. In the currently intensively-managed landscapes of the United States and Europe, remnants of biodiversity are relatively scarce, putting ecological solutions at risk. This pathway therefore requires a profound change in these intensive farming systems, so that time and investments will be needed to improve degraded ecosystem services.

3.2. Methods and findings from the MLP perspective

Although agricultural nature conservation as such is not a recent phenomenon, from an *MLP perspective* it can be regarded as an innovative *niche* as it is not business as usual nor a mere improvement of the current regime, but a type of land use in which agricultural production and nature conservation are combined. The question that can be asked from this approach is to what extent the niche is able to change the existing agricultural and nature regime. By delving into reports and literature on agricultural nature conservation and its history, techno-economic, socio-cognitive and governance issues can be found that influenced the development of the niche and the regimes. Other input came from focus groups with experts on the topic.

Agricultural nature conservation was for a long time what we can call a stabilized *niche*: a part of nature conservation was arranged in combination with agricultural production, but it did not increase in momentum or changed the existing agricultural or nature regime. However, recently, discussions arose on the role of farmers in rural areas, as the farms and kind of agricultural activity determines to a large extent how the rural areas look like. For instance, there are discussions on license to produce for farmers. Helping maintaining the rural areas and taking measures to help nature conservation is one way to create a license to produce. In 2013, around 11% (about 12,500) of all farms had contracts regarding nature or landscape management – which is a strong decrease from 27% in 2003 (Agriholland, 2015). However, in terms of total area, agricultural nature conservation has been relatively stable since 2000 (CBS et al., 2014). The subsidies that arable farmers get for nature and landscape is relatively small, but stable, compared to the profit they receive from their farm (Fig. 5) (Arnouts et al., 2013). For 81% of the farms that have agricultural nature conservation as the only secondary activity, this activity provided less than 10% of their total income in 2010 (and in almost all previous years) (Meurink, 2010). It is expected that without subsidies, only a quarter of the farmers would keep on managing the nature and landscape on their farms, and that will only be the 'light measures' (PBL, 2013a). The main motivations for farmers to become involved in agricultural nature conservation are therefore increase of income (Arnouts et al., 2013), with idealistic reasons being a secondary motivation (Leneman and Graveland, 2004).

Besides farmers, around 75,000 volunteers (mainly citizens, often not living in the rural areas) were involved to help maintaining the existing nature and agricultural areas in 2015, by developing new areas suitable for agricultural nature conservation and developing recreation areas. These developments are not only influencing the farmers but also the people living in rural areas.

Research regarding the effectiveness of agricultural nature conservation as a niche, showed that its success is determined by 1) the degree to which measures lead to improvement of habitats of the target species; 2) the intensity of agriculture in the area in which measures are taken and 3) the structure and diversity of the area (Kleijn et al., 2011). As the ecological effectivity of agriculture nature conservation has been limited so far, the system was changed in 2016 and budgets were decentralised: farmers can now only apply collectively for agriculture nature conservation in designated areas with large ecological opportunities. A first ex ante evaluation showed that in practice, not all of the designated areas have large ecological opportunities, which may limit the environmental impact of the new system (Melman et al., 2015; PBL, 2016). In fact, the regulations for nature agricultural subsidies in The Netherlands have been changed several times since 1975 - but with little success for nature conservation goals (Melman et al., 2007). Farmers were participating on a voluntary basis and could choose the kind of conservation measures they would like to apply. This resulted in many farmers choosing measures that were easy to implement but had low or zero ecological impact (Runhaar, 2016). Agricultural nature conservation may therefore not necessarily be the best solution to halt biodiversity loss in agricultural areas, but is an interesting niche to study for the future as it combines managerial and policy measures with technological measures in the field.

MLP-related research revealed that the dominant *agricultural regime* is characterised by agricultural intensification: a decreasing number of farms, and simultaneously an increase in the size of the farms in hectares or number of animals. Mechanization and the use of inputs such as water and minerals contributed to this trend. The agricultural regime is very locked in due to i) sunk investments mainly in machinery and buildings by farmers; ii) hard-to-change culture and habits of farmers who are focused on maximizing yields; and iii) the uneven distribution of power in the value chain, with many farmers but only very few purchasing companies (PBL, 2013b), leading to very few degrees of freedom on the side of the farmers. However, some cracks and tensions

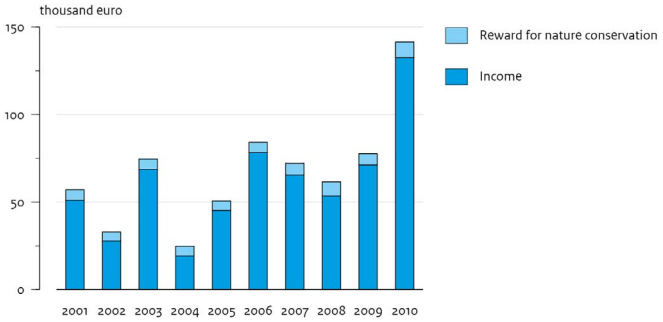

Fig. 5. Income of farmers and reward for nature conservation (Arnouts et al., 2013).

in this regime are visible which might lead to changes. These stem from more stringent regulations to counter environmental and public health problems, stronger societal awareness, and non-governmental organisations and the public opinion gaining more influence on the sector (Elzen et al., 2011). The license for farmers to produce is no longer taken for granted. Rising attention among consumers for healthy, authentic, sustainable, animal friendly, and locally produced products asks for different production methods (De Bakker et al., 2013; LEI Wageningen UR, 2014). For some – but not all – farmers, a solution to deal with decreasing incomes is to combine production with other activities in order to generate sufficient income, for example care, tourism or selling their own produce.

The *nature regime* is less locked-in compared to the agricultural regime, as there are less incumbent and powerful players dominating the 'market'. The cracks and tensions in the nature regime are strong mainly due to decentralisation of budgets from the (inter)national level to regional governments (provinces) (Schuerhoff and Ruijs, 2016): policy on nature shifted from connecting nature areas organised on the (inter)national level to a partly decentralisation of responsibility to local and regional governments and deregulation of landscape policies (Buijs et al., 2014), although the state remains responsible for the EU Natura 2000-goals. This change of responsibility aims to realize measures which better correspond to characteristics of the specific region. At the same time, the link between economy and biodiversity is being put to the fore in order to find ways to improve both simultaneously (win-win solutions). The importance and positive impact of nature on society has also gained attention, with The Nature Alliance[1] introducing the term 'natural capital'. Related to these developments, nature is increasingly combined with agriculture or water supply and financial resources from different sources are employed. This, together with budgets available for nature being under pressure (Kleijn, 2012), could spur niche-innovations on new ways to reward or finance agricultural nature conservation and more extensive agriculture.

At the *landscape level* characteristics were identified that have a stabilizing effect on the land use domain and might both hinder or encourage the development of agricultural nature conservation. The landscape level of the agricultural sector is strongly determined by The Common Agricultural Policy (CAP) of the EU (European Commission, 2014, 2015). The present CAP consists of two pillars: pillar 1 entailing a Common Market Organisation and pillar 2 the Rural Development regulation of Agenda 2000. Pillar 1 lays out the rules for providing market price support measures as well as direct payments. Pillar 2 consists of a list of measures from which member states can choose. Funding in this pillar requires co-funding at national or regional level (OECD, 2015). The CAP used to be a stabilizing factor, as it determines how the payments are organised. Adaptations of the CAP are discussed

[1] The Nature Alliance (Natuurpact, established 2013) is an arrangement between the national government and the provincial governments, in which agreements are made on developing the existing state targets for new nature (80,000 ha), improving the biodiversity and reaching international Natura 2000 nature goals.

on the European level, and can hardly be influenced in the region. However, the CAP is currently changing as recently discussions have started on its design after 2020. This is an opportunity to organise change. Other possibly destabilizing factors are the increasing urgency to deal with climate change, the changing demand of consumers (such as increased global meat consumption and population growth), and crises (such as floods, animal diseases and the financial crisis).

In the typology of Geels and Schot (2007) this transition can be identified as a Transformation pathway. In this type of pathway, the regime actors modify the direction of developments (towards agricultural nature conservation) as a result of moderate landscape pressure (changes in the CAP). Niche innovations have not yet been sufficiently developed and are under development to deal with the changes in policy.

3.3. Findings from the IBL perspective

The case studied here was the Initiative *Water Land and Dikes* (*WLD*), managed by farmers. It is studied with the IBL perspective (Zwartkruis and Westhoek, 2015): via interviews and document analysis the timeline of the case was reconstructed and insight was gathered on how the 'transition' process of WLD from an Agricultural Nature Association (ANA) towards a collective responsible for developing new services occurred (Zwartkruis and Westhoek, 2015). The focal question that was asked from this perspective is: What factors enable or disable the transition for initiatives on the ground that resemble 'transitions in the making'? There are numerous ANAs at local or regional level in The Netherlands, most of them established in the 1990s. These nature associations consist of people collaborating in the coordination and implementation of policies on agricultural nature conservation introduced by the government. The overall goal of an ANAs is improving the quality of nature and agriculture in their working area. The associations are mainly present in the northern and western part of the Netherlands as a lot of meadow birds live there (for other studies on the role of ANA's in grassroots developments, see Franks, 2010, Hermans et al., 2016).

WLD has started as a result of the fusion of two organisations in 2007 that existed already since the early 1990s in the area Lower Holland, an area in the north-western part of the Netherlands. WLD was able to make a quick start in its activities since they received substantial subsidies. This was mainly due to the 'natural handicaps' of the area, such as excessive water and many peat areas. Intensive agricultural production is hardly possible in this area, because not every piece of land can be reached by machines (or cows). This leads to lower income for farmers. There are, however, good conditions to combine nature and agriculture, and protect species that belong to such an agricultural landscape (Terwan, 2013).

Agricultural nature conservation is per definition occurring at the borders of the agricultural and the nature regime, so the initiators have to deal with differences in regulations and actors between the different regimes and have difficulties in acquiring resources. Farmers would be less willing to participate in agricultural nature conservation if it would lead to less productivity, but since 1975 they are compensated for reductions in production resulting from nature conservation. Activities related to agricultural nature conservation are therefore dependent on subsidies and regulations.

Initially, the main goal of WLD was to protect meadow birds. Due to changes in the CAP and in national policy the goals of WLD became broader. One of the most important changes consists of a more prominent role for collectives: in the past, individual farmers could apply for payments for nature and landscape maintenance at the provincial level, whereas from 2016 onwards only collectives can apply for these payments. Farmers and agricultural land users sign contracts with these collectives (Zwartkruis and Westhoek, 2015). Two other major recent changes in the CAP relevant for WLD were (Water Land & Dijken, 2014):

> Greening: A share of the direct payments for farmers that nowadays compensate for the low world market prices will be based on green services.
> The range of services is broadened with other themes, such as water, soil and climate.

Based on this background and due to these changes, WLD developed into a project organisation with a lot of knowledge on agricultural nature conservation. They have established a great knowledge base and as a result, they are viewed by the (national) government as a serious partner. WLD proposed to start a pilot to practice with the role of collectives in CAP, financed by the Ministry of Economic Affairs. After a selection procedure, WLD could develop their pilot from 2011 until 2014. In this course, WLD became regarded as a 'think tank' for the government.

As mentioned above, one of the future tasks of WLD will be the distribution of subsidies to the farmers in the area. The motivation for organising agricultural nature conservation in this way is to decrease administration and implementation costs for the government (from formerly 50% to 12–18%) (Terwan and Rozendaal, 2014) as it is no longer the individual farmer but the collective that needs to apply for subsidies. Furthermore, it is expected that organising agricultural nature conservation in local networks improves its quality because formerly a part of subsidies was given to parcels without nature values (Zwartkruis and Westhoek, 2015). Fig. 6 shows some of the most important events in the history of WLD.

The study of this local initiative revealed a strong governance influence. The government facilitated transitions by creating a space to innovate (by developing a pilot) and by providing subsidies, thereby

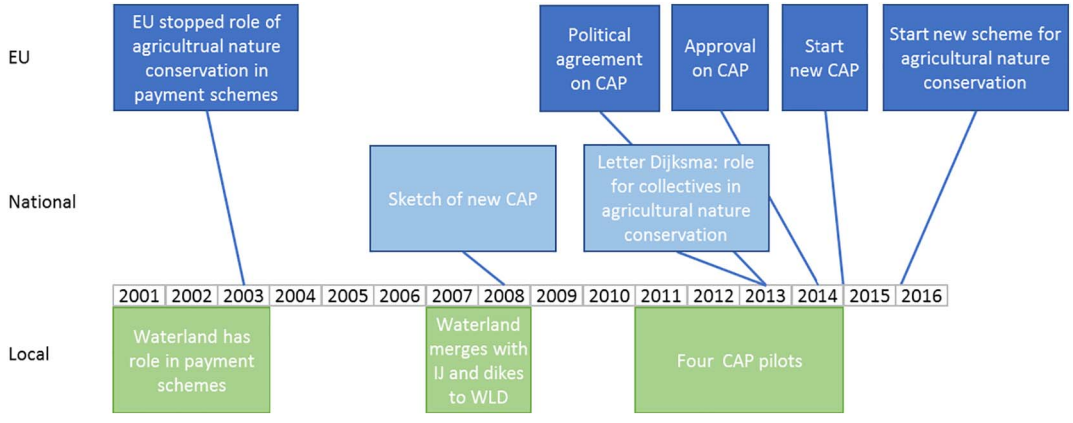
EU
National
Local
EU stopped role of agricultrual nature conservation in payment schemes
Political agreement on CAP
Approval on CAP
Start new CAP
Start new scheme for agricultural nature conservation
Sketch of new CAP
Letter Dijksma: role for collectives in agricultural nature conservation
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016
Waterland has role in payment schemes
Waterland merges with IJ and dikes to WLD
Four CAP pilots

Fig. 6. Timeline of most important events in the history of WLD.

creating a protected space for this innovation. However, ever-changing regulations led to uncertainties regarding the availability of subsidies in the future, making it difficult for farmers to take investment decisions. Hence, as long as high direct payments (based on production or area) exist, the incentive for agricultural nature conservation is limited. It will only be attractive for farmers to put effort in agricultural nature conservation if their production levels are insufficient. The focus will then be on production *or* landscape and biodiversity developments, while our study of interest is on the combination of the two. Therefore, it could be argued that currently subsidies could limit innovation as they only stimulate a development in the direction of higher yields. Furthermore, people will not be willing to invest in innovative ideas or new management tools if the future level of subsidies is unclear, as they run the risk of unprofitable investments.

The interviews in the case study showed that the local character of the organisation motivates people to join. An important reason for this is that farmers are approached by people from the organisation that know the area very well and know how to discuss measures or ideas. As such, locally organised initiatives can form a bridge between practice and policy. Some measures are more easily to take at a local level than at the national level, as the area specific characteristics as potential nature values of a parcel can be taken into account.

The developments around WLD illustrate the difficulties to encourage agricultural nature conservation with policy measures. As agricultural nature conservation needs to deal with two regimes (nature and agriculture), both with their own characteristics and institutions, it was sometimes hard to find measures that fit in both regimes. Different subsidy schemes existed for nature and agriculture. Combining them could simplify subsidy applications, but this is challenging as the goals and measures of the subsidy schemes sometimes conflict. For example, in order to improve biodiversity along the ditches, it is necessary to keep a certain amount of plants, while from the perspective of the water boards it will be better to mow all plants. Another difficulty is that due to the multifunctional character of the land, different payments have to be asked for at different institutions, demanding different information and implying a high level of bureaucracy.

Both the MLP and IBL analysis suggest that agricultural nature conservation strongly depends on subsidies, which implies that momentum may be vulnerable to changes in policy. However, the number of collectives is growing, as farmers can only receive subsidies via such collectives.

4. Combining the findings

In this paper, we argue that a combination of scientific approaches that analyse transition pathways can improve our understanding of such pathways. IAM defines potential measures to achieve (global) sustainability goals on biodiversity and climate while ensuring food supply, and MLP and IBL provide insights into what extent these measures are realistic based on current developments in the agricultural and nature regime and on practices at the local level (Fig. 7). More specifically, IAM analysis provides insights under which conditions multifunctional land use, and especially agricultural nature conservation, could fit in a pathway that achieves biodiversity and other sustainability targets simultaneously. MLP analysis delves deeper in how agricultural nature conservation, as a particular form of multifunctional land use, has been developing over time and whether it contributed to changing existing nature and agricultural regimes. Finally, IBL provides insights into how agricultural nature conservation is organised in practice. It shows the pitfalls and obstacles in encouraging nature conservation with policy measures, thereby revealing implications for future measures.

The MLP analysis showed that agricultural nature conservation as a niche is already under development since the 1970s. Nowadays it seems that it is becoming part of the existing regimes, but its potential for growth is limited therein, as not all agricultural land will be used for agricultural nature conservation given its lower potential for creating value. Agricultural nature conservation can then be seen as a stabilized niche: a movement that will not change the entire agricultural regime, but will remain small within this regime. In the framework of Geels and Schot (2007) this transition can be defined as reconfiguration. The main actors are still the regime actors, but their role in the system is altered. Parts of the current practices are changing and new roles are developed: The role of the national government, for instance, is becoming less prominent. The main push for this niche to become mainstream seems to arise from the developments around the CAP and the decreasing subsidies in the nature regime that create cracks in the current agricultural *and* nature regimes, from which agricultural nature conservation could benefit. The limited impact of agricultural nature conservation on the ecological quality is an important reason why the momentum still remains small, although there might be types of combinations of nature and agriculture for which both the license to produce for farmers and the increasing urgency to halt the loss of biodiversity are taken into account. However, the IBL case on WLD shows it is not easy to combine measures for both the agricultural and nature regime. Furthermore, the case shows the power of a good relation with other organisations and of a wide knowledge base in making a quick start that could lead to successful niche innovation. Fig. 7 provides an overview of the analyses' results and their implication in terms of policy advice. The relationships and information flows indicated here are used to discuss our findings made on the interplay between the three approaches in the following sections.

4.1. The relation between IAM and MLP

IAM analysis shows that a regime shift towards multi-functional and mosaic landscapes could be consistent with long-term global and European sustainability targets regarding climate, food security, and biodiversity. It frames the findings of the Dutch regime into a formalized context offering foci and levers for future analysis and it provides the relevance of analysing multifunctional land use by showing that it could fit in a broader transition in which multiple sustainability targets are achieved. The MLP analysis suggests that developments in the agriculture and nature conservation regimes fit mostly in a global technology/intensification pathway. Therefore, one reason why developments in agricultural nature conservation are not easy to implement could be that they go against the dominant agricultural land use regime in the Netherlands.

The MLP analysis shows how agricultural nature conservation is a niche developed at the borders of both the agricultural and nature regime. As both regimes have their own institutions and regulations, it is hard to realize innovations that have an impact in both regimes. MLP analysis shows how difficult it is to create such a development as characteristics of both regimes need to be taken into account. Furthermore, the effects on the ecology of agricultural nature conservation are only marginal, while there is a lot of financial support involved in agricultural nature conservation. Only when there is a fair and more fact based choice between the financing of broad and shallow or deep and thorough nature agriculture both the halt of biodiversity loss and the economic needs can be addressed at the same time.

4.2. The relation between MLP and IBL

By combining the MLP and IBL approach, we see how changes in the regime (especially the rules and regulations) influence the local initiative and the niche. The pilot of WLD is the result of changes in the landscape (namely the changes in the CAP), but is influencing the regime as well, as it sheds a light on how to deal with agricultural nature conservation in practice, e.g. by highlighting the difficulties in addressing the two regimes at once. As a prefiguration for a future shape of the regime this could indicate that a strong connection between the regime and niche or local initiative can help to make room for an

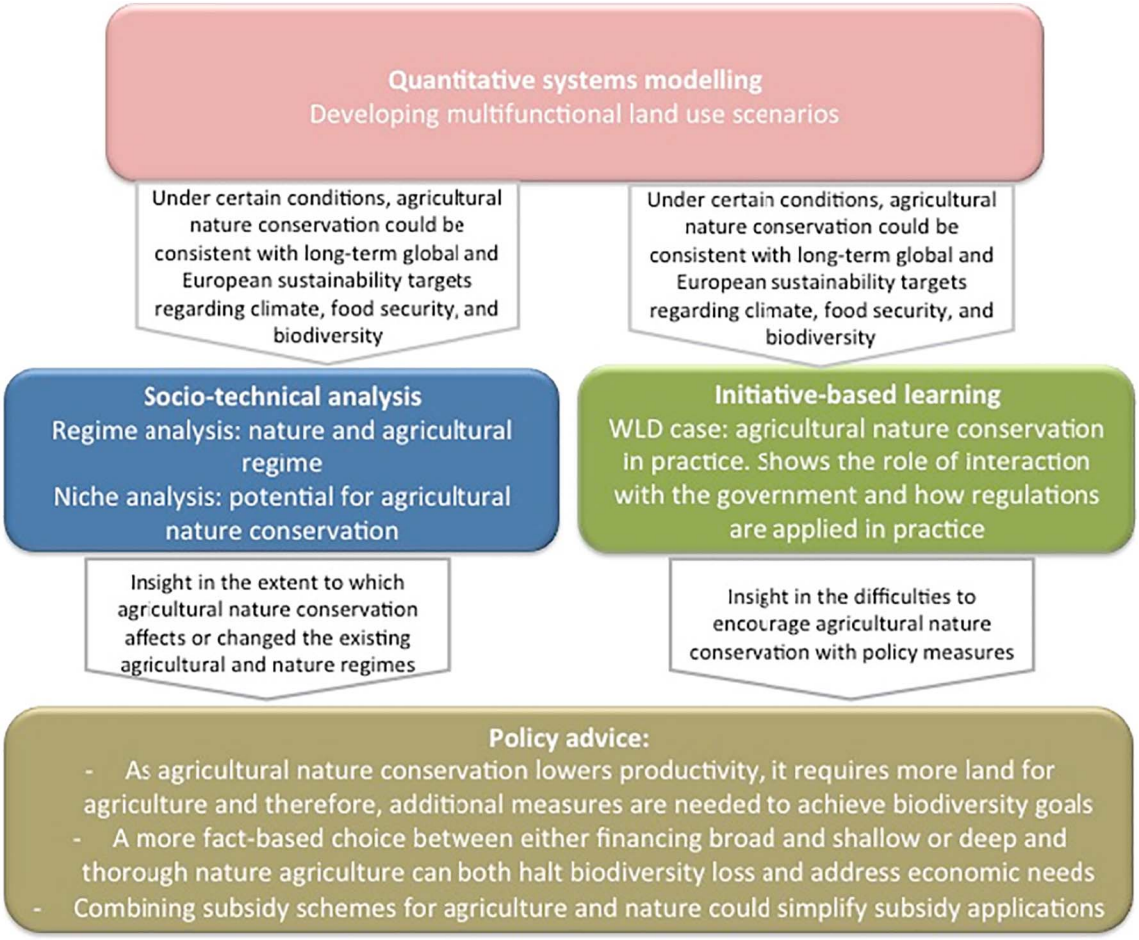
Quantitative systems modelling
Developing multifunctional land use scenarios
Under certain conditions, agricultural nature conservation could be consistent with long-term global and European sustainability targets regarding climate, food security, and biodiversity
Under certain conditions, agricultural nature conservation could be consistent with long-term global and European sustainability targets regarding climate, food security, and biodiversity
Socio-technical analysis
Regime analysis: nature and agricultural regime
Niche analysis: potential for agricultural nature conservation
Initiative-based learning
WLD case: agricultural nature conservation in practice. Shows the role of interaction with the government and how regulations are applied in practice
Insight in the extent to which agricultural nature conservation affects or changed the existing agricultural and nature regimes
Insight in the difficulties to encourage agricultural nature conservation with policy measures
Policy advice:
- As agricultural nature conservation lowers productivity, it requires more land for agriculture and therefore, additional measures are needed to achieve biodiversity goals
- A more fact-based choice between either financing broad and shallow or deep and thorough nature agriculture can both halt biodiversity loss and address economic needs
- Combining subsidy schemes for agriculture and nature could simplify subsidy applications

Fig. 7. Combining insights from IAM, MLP, and IBL – an example of agricultural nature conservation in the Netherlands.

innovation. If the regime actors are aware of their relations with the niche and local actors and the other way around, feedback between local initiatives and regime developments could be arranged to mutually improve the regime and the niche. Moreover, the distinct case in IBL showed how different regimes can affect each other directly through cross-regime knock-on effects – a finding that would likely have gone unnoticed in single regime analysis.

4.3. The relation between IAM and IBL

In the current case, IAM results can help to show how measures can or cannot contribute to achieving multiple sustainability targets on a larger scale, which may increase the policy attention given to the implementation of agricultural nature conservation. It is important to note that agricultural nature conservation is one way of multifunctional land use, and probably even more important, multifunctional land use might not be the best solution to deal with halting biodiversity loss. However, IBL can be used to critically evaluate the storyline, underlying assumptions, and model parameters used in IAM regarding the transition towards multifunctional land use by validating these based on the analysis of real life cases. Insights from both MLP and IBL can help to strengthen the assumptions made in models.

While IAM analysis show that multifunctional land use could be part of a strategy to achieve multiple sustainability goals, the MLP and IBL analyses reveal the struggles in practice when trying to deal with both regimes, and show that a multifunctional solution is often hard to realize. The IBL case is zooming in on one niche. It is too early to see the effect on the ecology of the measures taken in that very case.

5. Discussion

Although the three approaches used in this study have different time spans and focus on different developments, further linkages between the approaches can be made.

As the IBL analysis mainly addresses the stubborn reality of the social practices and the interactive patterns of stakeholders, IBL cases can be an addition to MLP analyses by providing directions for future developments within a regime or for new configurations within or after a transition. Practices, products and institutions developed and observed within the initiative may e.g. work as role models. IBL can provide IAM with narratives for future development as pre-figurations: What will happen if a specific innovation scales up? In this case the initiative would be used to calibrate the parameters of a model, for example by showing how policy measures or new practices work out in practice. Moreover, observations from initiatives may be used to show the struggles related to implementation of measures taken in IAM scenarios. In this way, IBL can also help to judge the feasibility of future IAM projections or as experiments whose outcomes can be fit into the models for testing their scope. However, local practices can differ a lot, complicating connecting IBL with IAM outcomes.

MLP captures reality in a framework with multiple levels and multiple actors and systems. MLP could therefore draw implications on actual chances for change, timelines required and mechanisms in place (e.g. non-linear feedback in a locked-in environment). MLP can therefore validate the assumptions of IAMs, and sets the cases in IBL into a more encompassing timeline so that their role and significance in relation to past and present occurrences e.g. with regard to regimes and transitions becomes clearer. In land use, changes are bounded by spatial

and ecological characteristics as well, and not only by technological feasibility. Therefore, it makes sense to not talk only about socio-technical systems, but also about socio-ecological systems, which are "complex and integrated systems in which mixed components of economic, social and environmental capitals interact across spatial scales (but within a geographically-bounded space) over a defined period of time" (Ferrara et al., 2016).

IAM can provide supporting narrative storylines, context, and set goals to MLP, i.e. set an on-going or past transition into reference of broader approaches, future trends or projected development. Similarly, IAM can, just like MLP but in a different way, provide context and focus to IBL cases and initiatives. IAM can also be used to assess whether innovative ideas may be seen as parts of a solution, or whether they could be detrimental for certain sustainability targets on a larger scale. Moreover, IAM forecasts, e.g. on climate change, may work as motivators or set agendas to start initiatives or keep them going, as such projections tend to receive ample attention from policy makers and civil actors. They are therefore an appealing tool for assessing the impacts of land use change on biodiversity globally. However, on smaller geographical scales the use of IAMs is more limited, as the resolution at which these models work is much broader than most biodiversity ranges and IAMS are not sensitive to local drivers of biodiversity loss (Meller et al., 2015).

Our analysis thus provided first insights into how the combination of different research approaches may improve the understanding of certain empirical observations related to transition pathways – in our case the role of agricultural nature conservation in a transition of the Dutch land use domain. An assessment of the ecological quality of this measure is not part of such an analysis; instead, the focus is on governance measures. It is hard to generalise findings from one case study to a modelling exercise, but MLP and IBL can help to criticize the assumptions and storylines made in models. In the end, many measures ask for changes at the local level, and as our analyses show, studying real life interactions and social relations provide insight into these mechanisms. Although in the MLP literature, the attention for actors and agency is increasing (see for example Farla et al., 2012), the focus of IBL is on studying their effect and even on starting or enforcing them in real life, while focusing on a local or specific situation. IBL brings in the practical struggles actors face in a local context, while the MLP perspective focuses on actors at a more general level (MLP focuses for example on the consumers instead of the people living in city X). So IBL brings in the local and practical component. Bridging different approaches as we did in this paper, leads to a deeper understanding of the underlying processes, reasons and motives and points towards potential future development and opportunities for intervention.

Further research can build on these insights and concentrate on specific analytical foci, such as governance or developmental dynamics. Such approaches could meaningfully deepen the more exploratory analysis performed here and thus allow for further insights both into the topic of transition pathways and into possibilities of integration of different research approaches.

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